

ABSTRACTS OF PAPERS

Seventh Annual Albert L. Tester Memorial Symposium

15–16 April 1982¹

The Albert L. Tester Memorial Symposium is held in honor of Professor Albert L. Tester who, at the time of his death in 1974, was Senior Professor of Zoology at the University of Hawaii. The faculty and students of the Department of Zoology proposed an annual symposium of student research papers as a means of honoring, in a continuing and active way, Dr. Tester's lively encouragement of student research in a broad range of fields within marine biology. Papers reporting original research on any aspect of biology are solicited from students at the University and these papers are presented at the symposium, which takes place during the spring semester. Income from contributions to the Albert L. Tester Memorial Fund of the University of Hawaii Foundation is used to provide two prizes for the best papers by graduate students in the Department of Zoology. Papers are judged on quality, originality and importance of research reported, as well as the quality of the public presentation. Judges include several members of the faculty of the Department of Zoology as well as winners of the symposium from the preceding year, when possible. In addition, a distinguished scholar from another university is invited to participate in the symposium as a judge and to present the major symposium address. This year Dr. Howard Bern of the University of California, Berkeley participated in the symposium.

Epizootiologic Study of Mid-Cycle Disease of Larval

*Macrobrachium rosenbergii*²

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Mid-cycle disease (MCD) of larval *Macrobrachium rosenbergii* has reduced survival of larval cultures at the state facility from a normal 50–70% of the population at the post-larval stage to 5–10%. Observations revealed a characteristic mortality pattern where a peak in daily mortality occurred near the middle of the rearing cycle.

Epizootiologic studies were initiated using existing facilities to define aspects of MCD and elucidate possible causes. Experiments were undertaken in duplicate culture tanks, each separated into 4 equal-volume compartments by a nitex screen. Water, algae, and

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some feed could pass between compartments; prawn larvae could not.

Reference larvae were introduced into a compartment of each tank on the day of hatch. Test larvae populations of different ages and sources were introduced into the remaining compartments at various times after the initiation of the experiment. Dead larvae in the bottom sediment were counted daily and mortality curves were generated. Length and developmental stage of live and dead animals in each compartment were assessed daily.

Results indicated that a toxic period of un-

known etiology began on the 10th day of culture and probably extended for the duration of the rearing cycle. Test populations introduced during the toxic period displayed a mortality peak within 4–6 days. Larvae at age 15 days (stage 6–7) or older appeared refractory to the toxicity.

MCD apparently reduced growth rates (length) but did not appear to selectively kill larger or smaller susceptible individuals. It was problematic that large numbers of animals lost from populations were not accounted for. Studies on MCD will continue.

Larval Development and Metamorphosis of the Prosobranch Mollusc, *Epitonium ulu*, Associated with a Solitary Coral

JANICE L. BELL⁶

In Hawaii *Epitonium ulu* has been found only on the solitary coral, *Fungia scutaria*. This degree of host specificity led to two opposing hypotheses. The first was that *Epitonium* would have a very short larval period during which time the larvae would never leave the optimal area for their host on the coral reef. The opposing hypothesis was that *Epitonium* could remain competent to metamorphose for a long period, until it encountered its host. A corollary to this second hypothesis is that larvae would metamorphose only in response to the coral *Fungia*. *Epitonium ulu* is extremely fecund for its size (mean adult length: 13 mm). During the summer each animal produces a mean of 32 capsules per day, each capsule containing 500–600 eggs. Embryos complete intracapsular development in 6 days and hatch as planktotrophic veligers.

Cultures of newly hatched larvae were set up to investigate the length of larval life, the growth of larval shell and tissue, and the metamorphosis of competent larvae. Larvae

were fed both *Isochrysis galbana* and *Pavlova lutheri* beginning on day 1 post-hatching, and these were supplemented with *Phaeodactylum tricornutum*, beginning on day 13.

Shell length increased steadily from 1 to 27 days post-hatching, after which it leveled off at 390 μ m. Tissue mass (ash-free dry weight) was more variable than shell length, but also increased steadily with age and leveled off after day 24. Twenty percent of the larvae were first capable of metamorphosis on day 27; this metamorphosis was induced with sea water that had been in contact with *Fungia*. Larvae began to metamorphose spontaneously (without contact with *Fungia*) on day 29. By day 36, 50% had metamorphosed and by day 60, all larvae had metamorphosed or died. The competent period may be even shorter than these data suggest. The 31-day span of spontaneous metamorphosis could have been caused by individual variability in attaining metamorphic size. Thus larvae may reach competence and metamorphose shortly thereafter. *Epitonium ulu* did not fit either hypothesis and seems to have little flexibility in where it settles. The lack of ability to remain in the plankton may be balanced by the high fecundity of this snail.

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The Impact of Eel Predation Reconsidered: The Populations of Potential Prey⁷

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From July 1980 through September 1981 a study was conducted to assess the impact of predation by moray eels on a reef fish community. The abundance of moray eels on an experimental patch reef was reduced by the trapping and removal of adults. The diurnal fish communities on this experimental and a nearby control patch reef were censused prior to the treatment and at four additional times during the following year.

The 8 most abundant species comprised 90% by numbers of the visually censused fish community. Analysis of variance was per-

formed on each of these 8 species to detect differences between reefs and differences over time. Contrast coding was used to test the significance of any divergence between corresponding experimental and control reef populations. Those species responding to the eel removal were expected to show such divergence. *Chaetodon miliaris* and *Dascyllus albisella* were the only two species to show significant population increases on the experimental relative to the control. It is noted, however, that certain assumptions of the experimental design and censusing technique are important enough to keep us from concluding that these species were indeed released from predator limitation. We intend to investigate these assumptions and to strengthen the inference of these results by replication.

⁷This research was supported by the Sea Grant Program, grant MR/R-11.

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Applications of a New Radiotracer Technique for Investigating Prawn (*Macrobrachium rosenbergii*) Ecology and Digestive Physiology

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Water stable, ¹⁴C radiolabeled, chemotactically active, bacteria-laden, artificial detritus was formulated by a rapid, simple method. It was used to follow the assimilation of bacterial macromolecules into the foregut, midgut, and tail tissue of aquarium-acclimated freshwater prawns, *Macrobrachium rosenbergii* (deMan) in time course experiments under conditions of starvation, heavy supplemental feeding, and sudden crowding. Over a 24-hr time course with starved prawns, the proportion of the label assimilated into lipid in the midgut and tail tissue increased 12.3% and 8.0%, respectively, with decreased pro-

portions of the label in carbohydrate in the midgut and protein in the tail tissue. Starved prawns incorporated similar proportions of the label in carbohydrate and protein of the midgut, as did heavily fed prawns, but shunted a larger proportion of the label into lipid. Protein was catabolized in order to synthesize lipid and appeared to be used as an energy source. Suddenly crowded prawns greatly elevated the amount of radioactivity proportioned into carbohydrates and lipids of the midgut at the expense of greatly lowered protein activities.

The formulation prepared here, which appears chemotactically and visually active as artificial "fish feces," may have wide applicability in many aquaculture pond ecology and nutrition studies.

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Does Glucose Uptake in Marine Fish Intestines Occur by Active Transport?

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Initial entry rates (influxes) of ³H-D-glucose in the upper and lower intestines of the surgeonfish (*Acanthurus mata*) and the eel (*Gymnothorax undulatus*) occur via two independent processes operating simultaneously: (1) a carrier-mediated transport system exhibiting saturation kinetics of the Michaelis-Menten type and (2) a linear entry process having a rate that is proportional to the external glucose concentration. This latter nonsaturable process represents 20–40% of total influx when external glucose concentrations are at least 0.5 mM. The direction of transport via this nonsaturable process may be reversed (i.e., from cell to gut lumen) if intracellular glucose concentration increases, thereby diminishing the ability of the intestine to effect a net movement of glucose from lumen to blood. Uptake studies showed that glucose was not accumulated by fish intestinal epithelia to concentrations significantly above those of control or Na-free media. Radioactivity in ethanol extracts of glucose-incubated tissues

was mostly volatile (e.g. tritiated water; 50–75%); whereas control studies using a non-metabolizable, actively transported analog of glucose (3-O-methyl-³H-D-glucose) resulted in volatile fractions amounting to less than 5% of total activity. Thin layer chromatography of these ethanol extracts showed that the smaller nonvolatile activity fraction was mostly (greater than 90%) glucose. Absence of Na in incubation saline reduced glucose uptake in the surgeonfish lower intestine and in both the eel intestinal segments, but not in the surgeonfish upper intestine. This latter effect was probably due to the relatively low affinity of this tissue for glucose. Thus, marine fishes have opted to metabolize a significant fraction of transported glucose to (1) maximize energy-independent downhill uptake of this substance into the cell from the gut lumen, and (2) minimize its efflux into the luminal medium. This study further suggests that marine fish intestine may differ, in part, from that of freshwater and terrestrial vertebrates, which can actively transport glucose, because in these fishes diffusional entry of the sugar into epithelial cells from the lumen may be of importance in net solute flow to the blood.

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Conditioning in Honeybees¹⁰

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The performance of free-flying honeybees (*Apis mellifera*) is studied under conditions analogous to those used for the analysis of learning in vertebrates. The training procedure, much like that developed by von Frisch

for the study of sensory processes, is to permit an animal to feed on a target marked with a distinctive color or odor, or both, and then to record its responses to an unbaited target. One series of experiments, in which the properties of compound stimuli are being explored, provides strong support for the hypothesis that a compound functions as a sum of its components (Pavlov's summation hypothesis). For example, after separate rewarded experiences with a color and an odor,

¹⁰ This research was supported by grants BNS75-21672 and 79-05876 from the National Science Foundation to Dr. M. E. Bitterman.

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honeybees respond more to the color and odor in compound than to either of the components alone (summation of excitation); while after separate nonrewarded experiences with the same components, they respond less to the compound than to either of the components alone (summation of inhibition). Stimulus compounds do have unique properties for honeybees. For example, after experiences with two color-odor compounds, bees respond more to those compounds than to the two others that can be constructed of the same components. Compound uniqueness, which is found also in vertebrates, does not contradict

Pavlov's summation hypothesis. It is reasonable to assume that afferent interaction generates a compound-specific product which is rewarded along with the components in training with the compound. The results of these and many other experiments with honeybees are strikingly similar to those for vertebrates. The similarity may be surprising in view of the remoteness of common ancestry, but perhaps not so surprising in view of the near-identity (homology?) of synaptic mechanisms and the likelihood that many of the phenomena being studied may eventually be understood in simple synaptic terms.

Feeding Behavior of *Chaetodon unimaculatus* in Kaneohe Bay

EVELYN COX¹²

Coral feeding by reef fishes can exert a considerable influence on coral community structure through impacts on growth and survival of coral colonies. Patch reefs at the north end of Kaneohe Bay characteristically have an extensive coral cover. On Tom's Reef, the study site, the patch reef top consists of approximately 50% *Porites compressa* and 50% *Montipora verrucosa*, but the slope is dominated by *P. compressa*. The coral feeding chaetodontid, *Chaetodon unimaculatus*, is abundant on Tom's Reef, often forming large aggregations of 20 or more fishes on the slope.

Observations by P. Motta at Haunama Bay indicated that *Chaetodon unimaculatus* prefers *Montipora* sp. and *Leptastrea* sp. as food. In order to begin a study of the interaction between selective feeding by *C. unimaculatus* and the distribution of *M. verrucosa* on patch

reefs in Kaneohe Bay, preliminary feeding preference tests were conducted in the laboratory, with supplemental observations of foraging behavior on Tom's Reef.

Chaetodon unimaculatus were maintained in flow-through seawater tanks at the Hawaii Institute of Marine Biology. Feeding preference was tested by offering equal sized colonies of *Montipora verrucosa* and *Porites compressa* and recording the number of bites on each species during a 30-minute trial period. Five fishes were tested for preference (26 trials total), and a Goodness of Fit test, using the extrinsic hypothesis that equal numbers of bites should be taken from both coral species, showed significantly more bites were taken from *M. verrucosa* ($p < 0.001$). Field observations of 4 tagged fishes also supported this finding; in 17 observation periods of 15 minutes each, significantly more bites were taken from *M. verrucosa* than from *P. compressa* ($p < 0.001$).

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Feeding and Spatial Organization of Three Species of Pomacanthid Fishes¹⁴

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This study explores the feeding behavior and spatial organization of three sympatric species of Caribbean angelfishes (family: Pomacanthidae): *Holacanthus tricolor*, *Pomacanthus paru*, and *Pomacanthus arcuatus*. Saturation diving from the NOAA Underwater Laboratory System I, off the coast of St. Croix, U.S. Virgin Islands, allowed extended periods of field observation of these wide-ranging fishes. Seven *H. tricolor* were captured, measured, sexed, marked by finclipping and released. Seven *P. paru* and six *P. arcuatus* were identified individually by natural markings.

Marked *H. tricolor* spent much of the time concealed under ledges. Male home ranges were relatively large ($\bar{x} = 907 \text{ m}^2 \pm 35 \text{ m}^2$, $N = 2$), encompassing the home ranges of up to three females, with whom he interacted. The home ranges of these females overlapped, averaging $335 \text{ m}^2 (\pm 175 \text{ m}^2, N = 5)$ in size. These observations suggest that *H. tricolor* exhibits a harem social system. During forays away from shelter, feeding was directed towards algal turf and several species of sponges.

P. paru and *P. arcuatus* are closely related and morphologically very similar. Their behavior differs greatly from that of *H. tricolor*. Individuals of both *Pomacanthus* spp. formed stable pairs with members of the same species. These pairs frequented large (2000–2500 m²), intraspecifically exclusive home ranges. Individuals spend relatively long periods of time in nonforaging activities. Such periods include extensive movements but very little sheltering. Preliminary data indicate that *P. paru* feeds primarily on sponges, and to a lesser extent on gorgonians and algae. *P. arcuatus* take approximately the same number of bites on each of these food types.

It seems likely that *H. tricolor* are harem and perhaps sex-reversing. The two *Pomacanthus* species, on the other hand, appear monogamous and possibly gonochoristic. Currently sociobiological theory predicts that these different social systems are determined in part by the distribution and abundance of critical resources. Although all three species feed on many of the same sponges, the two *Pomacanthus* spp. differ from *H. tricolor* by exploiting gorgonians as a food source. In addition, they show differential use of shelter. These are suggested as possible determinants of social organization in these species, and research is continuing on these aspects.

¹⁴This research was supported by NOAA Contract No. NA81AAA02688.

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The LD-50 Concentration and the Effects of Alcohol on the Fertility of the Nudibranch Mollusc *Phestilla sibogae*

CEDAR KEHOE¹⁶

The LD-50 concentration of alcohol in seawater was determined for the nudibranch mollusc *Phestilla sibogae* exposed for 24 hours. In conjunction with the experiments designed to establish the LD-50 value, data

were collected to determine the effects of the alcohol on the fertility of the egg masses laid by the animals. Analyzing the effects of alcohol on *P. sibogae* is an important step in demonstrating the feasibility of using these animals to produce alcohol-tolerant and alcohol-dependent strains through directional selection experiments.

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A New Hypothesis to Explain Aspects of Coloration in Chaetodontid Fishes

CHRISTOPHER KELLEY¹⁷

Using black bars, black spots, and "poster" patterns, the 3 basic types of color patterns that occur in chaetodontid fishes, 47 different hypothetical combinations were generated and evaluated for their potential effectiveness in reducing predation. Each of the 114 species of chaetodontids was then classified as one of the combinations. Over 90% of the species have bars that conceal their eyes and thus conceal a possible predator search image. Eye concealment alone fails to account for eyespots, bars, or other posterior patterns that occur in 88% of the species. Combinations where these patterns could possibly deceive predators regarding the orientation of the fish by making the anterior and posterior ends symmetrically equivalent or reversed occur in only 47% of the species. As pointed out by previous authors, poster coloration may function as a warning to predators; however, this hypothesis fails to explain either the shape or the widespread occurrence of conspicuous patterns on the posterior end.

Consequently, a new hypothesis is proposed to explain these patterns, the Visual Contact Hypothesis, which is that posterior

coloration functions to increase the optical signaling properties of the individual when seen from behind, enabling following conspecifics to maintain visual contact. In chaetodontids this may occur because predation is minimal, and because conspecifics locate each other visually. Their compressiform shape and general body color make it very difficult to see them from behind during following, which is a frequent and important social behavior.

This hypothesis differs from previous ones in two major respects. First, in a large number of chaetodontids, it accounts for both the location and the shape of conspicuous color patterns. This includes not only large patches and bars whose shapes are determined by the posterior body curvature, but small black patches or spots on the caudal peduncle or nape which produce highly visible flicker signals as the caudal fin sweeps back and forth during swimming. Second, it appears to be the first testable hypothesis. Several neurophysiological studies are being considered as the initial experimental approach, while comparative studies will be undertaken to examine such aspects as depth, home ranges, orientation during following, and size in chaetodontids as well as in other families of fishes where the hypothesis is applicable.

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Sexual Reproduction in the Solitary Scleractinian Coral, *Fungia scutaria* (Lamarck)

DAVID A. KRUPP¹⁸

A fortuitous set of circumstances led to the recognition and observations of spawning and larval development in the solitary scleractinian coral, *Fungia scutaria*. Spawning

occurred monthly through summer and early fall. The eggs, lacking the symbiotic zooxanthellae algae seen in the adults, measured approximately 84 μ m in diameter. No fertilization membrane was discernible, but there appeared to be a jelly coat. Cleavage was complete, polar, and irregularly radial. Slow

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moving, ciliated larvae were observed within 18 h of spawning. These developed mouths and seemed capable of feeding within 39 h. By this time the planulae were highly mobile, but tended to be positively geotactic. Planulae found in the aquarium tank in which the adult corals were being maintained became infected with zooxanthellae within 4 to 5 days after spawning. Attempts experimentally to infect laboratory-reared planulae lacking the sym-

bionts yielded ambiguous results because of high mortality of planulae. Settlement was similarly ambiguous. Although planulae were found attached to glass slides placed in the aquarium, those planulae usually did not remain attached. Mechanical dislodgement of attached planulae induced mobility after a short quiescent period. Only two developing settled polyps were found.

Magnetite in the Green Turtle

ANJANETTE PERRY¹⁹

Migratory green turtles, *Chelonia mydas*, can accurately navigate in the open ocean over distances of several hundreds to thousands of kilometers. Numerous guidance mechanisms for their feeding to breeding site journeys have been postulated, but few have been examined experimentally. Preliminary data suggest one navigational cue may be the ability of the green turtle to detect the geomagnetic field.

Biogenic magnetite, a possible transducer of the earth's magnetic field, has recently been discovered in a variety of marine species, ranging from invertebrates to pelagic fish and marine mammals. In order to determine if *Chelonia* also possess magnetite, hatchling,

juvenile, and adult specimens were tested for magnetic remanence using superconducting magnetometers. Saturation induced magnetic remanence one to two orders of magnitude greater than background noise was found in the heads of all turtles examined, and was localized to the dura mater in the adults. Samples were subsequently subjected to alternating field demagnetization and were found to be magnetically stable.

Dura tissue from six juveniles and one adult was digested with hypochlorite solution (household bleach). The residue was examined microscopically and numerous opaque magnetic particles were removed. X-ray diffraction and microprobe analysis of the particles showed that they were composed of very pure magnetite crystals. Scanning electron microscopy revealed unique spherical crystals, which have not previously been reported in biological samples.

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The Dispersal Potential of *Pocillopora damicornis* Planulae, Based on Larval Physiology and Behavior

ROBERT RICHMOND²⁰

The hermatypic coral *Pocillopora damicornis* (Linnaeus) is distributed across thousands of kilometers of the tropical Pacific, which raises the question of larval dispersal potential.

The larvae, which are approximately 70% lipid by body weight, contain an average of 0.63 calories per individual and 7.5 calories

per mg ash-free dry weight. During photosynthesis, approximately 13–27% of the carbon fixed by the symbiotic zooxanthellae is translocated to the animal portion of the larva.

Planulae have been found to remain competent for over 3 months, and they possess the ability to return to the planktonic state after having settled and calcified.

Considering energetic inputs of the symbiotic zooxanthellae, stored energy reserves, and behavioral adaptations, long-range dispersal of planulae from *P. damicornis* may be possible.

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Notes on the Biology and Feeding Habits of *Caranx ignobilis* and *Caranx melampygus* in the Northwestern Hawaiian Islands

ANTHONY SUDEKUM²¹

Caranx ignobilis and *Caranx melampygus* (Carangidae) are top-level predators of the coral reef communities of the northwestern Hawaiian Islands. An analysis of the diets of these two closely related, sympatric jack fishes revealed that both are top-level carnivores. Shallow-water reef fishes of the families Labridae, Scaridae, and Priacanthidae were found to be important in the diets of both species, though there were significant differences in the relative importance of these and many other diet items. Stomachs of *C. ignobilis* contained large numbers of nocturnal and pelagic fishes, crustaceans, and cephalopods,

while the prey of *C. melampygus* consisted almost entirely of diurnally active reef fishes. Dietary overlap between top predator species was compared using the Shannon-Weaver index of overlap. Minor overlap (.20) was indicated between *C. ignobilis* and *C. melampygus*, and a relatively large overlap (.61) was found between *C. ignobilis* and the grey reef shark *Carcharhinus amblyrhynchos*. Both carangids appear to be reproductively active throughout the year, with some evidence of summer spawning peaks. Skewed sex ratios for fish caught in large schools indicate the possibility of monosexual prespawning aggregations for *C. ignobilis*. These two large, wide-ranging piscivores appear to be very important in determining the structure and composition of the coral reef fish communities of the northwestern Hawaiian Islands.

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The Likely Site of the Magnetic Sense Organ in Yellowfin Tuna (*Thunnus albacares*) and Blue Marlin (*Makaira nigricans*)²²

MICHAEL M. WALKER²³

The problems we face in understanding animal navigation are epitomized by the migrations of pelagic marine fishes. It is very unlikely that fish could use the sun compass or other known orienting mechanisms to guide pelagic migrations. There is a growing body of indirect evidence that magnetic sensitivity is a very important orienting mechanism for migratory animals. This paper reports successful conditioning of yellowfin tuna (*Thunnus albacares*) to magnetic fields and an investigation of the possibility that the physical basis for a magnetic sense in both the yellowfin and the blue marlin (*Makaira nigricans*) is biogenic magnetite deposited within the ethmoid bones of the skulls of both species.

Yellowfin tuna were trained using a discrete trials-fixed interval testing paradigm to discriminate between the normal Hawaiian magnetic field and an altered field generated by a coil encircling their tank. Fish were trained to produce or withhold a conditioned response, i.e., swimming through a plastic pipe frame lowered into the water for 30 sec trial periods, in anticipation of positive or negative reinforcement. Studies using the cryogenic magnetometers at Hawaii Institute of Geophysics

and California Institute of Technology set out to identify concentrations of magnetic material within the bodies of yellowfin tuna and blue marlin. Where concentrations of magnetic material were found, the tissues were demagnetized in an alternating field to determine the coercivity of the magnetic material.

All yellowfin tested for magnetic sensitivity learned to discriminate between the two magnetic fields after two 30-trial sessions. Control trials were performed with one fish by interrupting the circuit between the DC power supply and the coil around the experimental tank. All other procedures continued as before, but discrimination between the positively and negatively reinforced trials ceased. Discrimination by the fish was reestablished when the circuit was recompleted providing good evidence for the existence of a magnetic sense in these fish.

Concentrations of magnetic material were predictably found within the ethmoid bones of the skull of both the yellowfin tuna and the blue marlin. Examination of the coercivity and other properties of the magnetic material showed that it was single-domain magnetite in both cases. Theoretical analyses imply that the amount of magnetite present is sufficient to provide these fish with a very sensitive magnetoreceptor if the magnetite is linked to the nervous system. This finding of magnetite in the same structure in species from different families of pelagic fish strongly suggests that magnetite deposited within the ethmoid bones is the basis of the magnetic sense organ.

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Conspecific Attraction in a Territorial Damselfish: Analysis of the Spatial Distribution of *Stegastes fasciolatus*

WILLIAM J. WALSH²⁴

The spatial dispersion patterns of a permanently territorial, algivorous damselfish were examined before and after an unusually severe storm. As a result of the storm, large numbers of individuals shifted their territories from shallow reef flat areas to deeper, more protected ones. Territorial movements in these areas during the early post-storm period resulted in a distinct clumping of territories which continued throughout the first post-storm year.

Comparisons between mapped distribution patterns and the descriptions provided by three ecological measures of dispersion showed marked differences in the accuracy

and usefulness of these procedures. Point nearest neighbor analysis inadequately described observed patterns. Circle nearest neighbor analysis and Morisita's index of dispersion provided increasing amounts of information and reliability.

Post-storm aggregation was unrelated to topographic heterogeneity or to the influence of competitors or predators. Attraction between conspecifics was implicated as being the primary driving force producing the observed territorial aggregation. Consistent with this influence were the patterns of subadult colonization and the adult reoccupation of vacated territories. A review of other studies suggests that conspecific attraction may be an important and often underestimated factor in the determination of spatial patterns among coral reef fishes.

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